



## **BEST Generic Game Rules**

### **GMRK00001 Revision 8; August 2011**

#### **1.0 Overview**

This is a youth oriented contest. The youth will gain the most if they do the work. Mentors and coaches are to provide guidance only and not to make parts, detail design, nor force their will on the youth.

The rules governing the BEST competition consist of the following:

1. Game Specific Rules (may supercede Generic Game Rules)
2. BEST Generic Game Rules (this document)
3. Returnable Kit List
4. Consumable Kit List
5. On-line Question and Answer (Q&A) system

Most questions about the game can be answered by first **READING THE RULES THOROUGHLY**. All questions concerning these rules (during the 6-week design and construction phase, not during the competition) must be submitted to the Game Committee in writing through the web-based interface at **<http://www.bestinc.org>**. All questions and answers will be distributed to all teams via the web. Responses to the posted questions on the web site are an extension of the rules. In the event of contradiction between the rules and the Q&A responses, the Q&A responses supersede the rules.

## **2.0 Safety**

Due to the nature of events in which electrical equipment and tools are used, safety may not and will not be compromised.

1. Safety first.
2. The referees will disqualify any machine that appears to be a safety hazard.
3. Batteries, chargers, and other components of the BEST Control System Kit may not be tampered with.
4. Except for a power drill/driver and a soldering iron (or soldering gun), no power tools (including battery operated) will be allowed in the pit area during any BEST activity. Common hand tools will be allowed. The power drill/driver may be used for drilling and/or hardware insertion/removal, but not for grinding, sawing, routing, etc. Power tools are to be operated only in the pit area or in the hub designated workstation area.
5. All individuals working on the machine in the pit area must wear safety gear appropriate to the activity (e.g., safety glasses should be used when soldering or drilling).
6. Any illegal tools may be confiscated for the day.

## **3.0 Robot Constraints**

### **3.1 Material Constraints**

Each team receives two kits: a returnable kit and a consumable kit. Each machine must be constructed using only the materials that appear on the returnable and consumable kit lists (provided in separate documents). Exceptions to this rule are described in Section 3.1.4.

The Returnable Kit List and Consumable Kit List are the official references for parts; therefore, they define the type and quantity of parts that can legally be used on the machine. The team is responsible for confirming that items in the received kits are consistent with the items on the lists and include no excess parts. Excess parts may not be used.

#### **3.1.1 Construction Requirements**

1. All robot construction is to occur during the six week competition period. There should be no part construction prior to the Game Kickoff Day nor reuse of parts from previous competitions. Robot parts may be permanently marked (via

scribing, drilling holes, etc.) by BEST personnel to identify the year in which they were built.

2. Motors must be mounted using the provided motor mounting plates and screws. The mounting plates may be modified (bent-up or cut-down), but the motors must be secured from spinning by being face-mounted with these plates.
3. The VEX Cortex Microcontroller and batteries must be secured to the robot. The Cortex microcontroller must be mounted to your robot using #8 screws through the holes provided on its base.

### 3.1.2 Returnable Kit

1. All Returnable Kit items, including boxes and packing, **must be returned** at the conclusion of the contest in the same condition as received except as noted in item 2 below.
2. Returnable Kit equipment cannot be modified in any way, with the following exceptions:
  - a) The belt stock supplied in the returnable kit may be modified as needed (e.g., cut, holes punched, etc.); however, the belt that is provided as loop may not be modified.
  - b) Servo horns may be modified as desired.
3. The Returnable Kit List specifies certain items that may not be attached to the machine (e.g., the battery chargers).
4. The motors and servos may not be opened for any reason. For example, it is illegal to change the gearing or to re-wind the armature of any motors.
5. The pulleys, bearings, and shoulder screw included in the return kit may not be modified. You may not use any glue or adhesive tape on these items.
6. Tape/adhesive/glue may not be applied to any returnable items. The adhesive portion of the supplied Velcro<sup>TM</sup> brand hook and loop fastener may not be attached to the battery or to any other returnable items.
7. Paint may not be applied to any returnable item.
8. The VEXnet Joystick, servos, VEX CORTEX Microcontroller, VEXnet 802.11 Keys, batteries, and battery chargers may not be tampered with, modified, or adjusted in any way. The only exception is that the VEX CORTEX Microcontroller may be programmed as desired.
9. Teams may not put labels or rubber bands on the VEXnet Joystick, nor make internal, reversible modifications to the joysticks.

10. Wires may be soldered to the motor power lugs.
11. Only the motor controllers or servo power adapter cables may be plugged directly into the VEX CORTEX Microcontroller motor ports. Motor ports 1 and 10 cannot be used (do not plug the screw terminal motor interface cables into these ports). Only the screw terminal sensor interface cables may be plugged directly into the VEX CORTEX Microcontroller digital input/output ports. No other connection methods to the Cortex may be used. Soldering to the Cortex microcontroller or to any of the interfacing cables is not allowed.
12. The 7.2 Volt NiMH 3000maH batteries are the only allowed source of electrical power for the functional components of your entire machine.
13. The 7.2 Volt batteries may **only** be connected to the VEX CORTEX Microcontroller through the supplied mating connectors. Do not attempt to connect the 7.2 Volt batteries to any other CORTEX input other than the battery connector.
14. Only one 7.2 Volt battery may be used on the machine during a match. Even if unconnected, the other battery may not be on the machine.
15. On Game Day, replacement batteries will only be provided upon proof of battery failure (e.g., a bad connection) on an exchange basis (you must turn in the bad battery).
16. You must play all your Game Day matches using the 7.2 Volt batteries supplied by BEST. Team-owned batteries (that power the robot) are not allowed on the field or in the pit area on Game Day; however, team-owned batteries are allowed during other BEST activities.
17. You may use the provided AAA rechargeable batteries or team provided batteries in the VEX Joystick.

### 3.1.3 Consumable Kit

1. Consumable Kit parts may be modified as desired within the constraints of these rules.
2. Limited numbers of replacement parts may be available from your local hub, upon a justified request. Otherwise, lost or damaged kit material may only be replaced with identical components. Replacement parts purchased by the team must have the same:
  - a. material as the kit part;
  - b. treatment or grade as the kit part; and;
  - c. dimensions as the kit part.

e.g., replacement plywood must be the same grade as the kit material; a 1x4 may **not** be replaced with a 2x4 of the same total volume.

3. The Consumable Kit includes optional items that may be provided by the team and used on the machine.

#### **3.1.4 Additional Materials & Constraints**

1. Lubricants may be used for lubrication only. A machine may not intentionally contaminate the playing field or an opponent's machine with lubricant.
2. Paint, stickers, and/or decals may be added as decorations only, but may not be applied to any returnable items.
3. Other non-functional decorations are only permitted as long as they do not aid the machine in performing the game. If you can remove it (and you may be asked to) and your machine behaves the same, it is probably non-functional. Prohibited decorations include:
  - a. strobe lights;
  - b. cameras,
  - c. any device that transmits or receives signals to/from an external device.
4. Non-functional decorations may use a separate power source (e.g., 9V battery).
5. Decorative items may be used to give visual information without being considered "functional" provided that they are visually static (unchanging). Examples of what is allowed would be things such as labeling machine parts with a marker, placing a copy of the Cortex port use schematic on the machine, using colors to identify areas or items on the machine and so on.
6. You may solder electrical wire connections using your own solder except where electrical connectors are provided. Where connectors have been provided (i.e., on the VEX CORTEX Microcontroller, servo power adapter cables, servo extension wires, batteries and other returnable items), they must be used without soldering to the connector. Solder may be applied to connectors included in the Consumable Kit (e.g., bullet connectors).
7. No welding, brazing or structural soldering is allowed.
8. Metal, rubber, and plastic items may be heated and reformed, but may not be melted and re-cast.
9. Materials may not be changed chemically. The exceptions are that strings may be singed to prevent loose ends and that resin and hardener may be mixed to result in epoxy.

### 3.2 Size

1. At the start of each match, the machine must fit, **unconstrained**, within a cubic space that is 24 inches on a side. The machine must remain within the maximum size limit, unconstrained, until the beginning of the match.
2. Once the match begins, the machine may unfold and change size through its own power.
3. There is no size requirement at the end of the match (i.e., the machine does not have to return to its initial configuration).

### 3.3 Weight

1. The weight of the machine may not exceed 24 pounds, including the battery and all parts and devices of your machine (e.g., detaching pieces, optional equipment, tethered parts, etc.).

### 3.4 Energy Sources

1. The energy used by the machine must come solely from:
  - a. electrical energy derived from the single onboard battery pack;
  - b. storage achieved by the deformation of the springs provided in the kit;
  - c. a change in the altitude of the center of gravity of any part of the machine; and/or;
  - d. stretched rubber from the inner tube, rubber bands, or shock cord, provided that the part is attached to the machine so that it will not fly off if broken.

### 3.5 Compliance

1. All machines will be inspected for compliance with the regulations before the competition. Machines must meet these regulations to qualify for the competition. The winning machines may be inspected again following the tournament. Failure to comply with the regulations will result in disqualification.
2. No substitute machines are allowed. Machines may be modified between rounds but must still meet all the regulations after the modifications are made. The compliance official must approve all modifications prior to the next round of competition.

3. Random re-checks of machines will be performed throughout the day at the discretion of the referees. Any machine found to be non-compliant will not be allowed to continue the competition until brought into compliance and may be disqualified from prior matches.
4. The machines may not leave the competition site between the time they are checked for compliance and the start of the competition without approval from the competition officials.
5. Teams that place high enough to advance to a regional/national competition are allowed to make repairs and/or functional improvements to their machine. Machines will be rechecked for compliance prior to the regional/national competition.

### **3.6 General**

1. Machines must be designed to operate by reacting only against the surfaces of the playing field (including the PVC pipes, ramps, etc), the opponents' machines, and the air. Machines are allowed to clamp to anything in the field except another machine.
2. During a match, the machine may only be controlled through normal operation of the VEXnet system. Touching the robot will result in penalty or disqualification as described in section 4.3.
3. No external devices may be connected to the joystick during match play (with the exception of the auxiliary joystick field power supply if provided).
4. Machines must prominently display their machine number and the school's or team's name or logo.
5. Powered tandem devices are permitted and may use an umbilical to connect the two devices. This umbilical is considered part of the machine and is subject to the same constraints as the rest of the machine.
6. All projectiles must have a frontal area greater than 10 square inches. A projectile is anything launched through the air, whether free flying or tethered. Parts that detach or fall from a machine and remain on the playing surface are not considered projectiles.
7. Gaining traction or gripping game pieces by the use of adhesives, or by abrading or breaking the surface of the field is not allowed.
8. Spiked wheels are allowed only if the portion of the spike in contact with the field has at least one dimension greater than 1/4 inch.
9. Strategies aimed only at destruction, damage (e.g., stabbing, cutting, etc.), overturning, or entanglement of an opponent's machine are not in the spirit of the

competition and are not allowed. Turning over an opponent's machine may or may not result in a penalty depending on the opinion of the referees. Review section 4.3 for a description of penalties for overly aggressive actions.

10. Machines may deploy detachable components on the field. A component is considered “detached” if it has no kit parts connecting it, directly or indirectly, to the set of kit parts that includes the battery. Such components may be used to capture, contain, manipulate game pieces, and/or block another machine. Such components may not be launched at, deliberately attached to, or otherwise deliberately used to entangle another machine. Incidental contact between any machine and such detachable components after deployment will not result in a penalty for any team. Detached components will not count as “part of the machine” unless otherwise stated.
11. Following the contest, all items provided in the Returnable Kit must be returned to the hub (local BEST organization). The rest of the machine may be retained by its respective school.

## **4.0 Tournament**

### **4.1 General**

1. There will be at least five referees during each match. The Head Referee will act as timekeeper and the other four referees will monitor each of the teams.
2. Referees have ultimate authority during the competition. No protests will be allowed.
3. On Game Day there will be individuals identified to answer questions about the game or rules. Do not approach referees (or others) with questions.
4. During the tournament, a maximum setup time of 30 seconds will be allowed once the team arrives at the field. Teams will be notified of their field and position assignment at least two minutes before the match. Teams must be in the staging area at the end of the preceding match.
5. At the start of each match, the machine must be placed at the designated starting area. The spotter or driver may enter the field prior to the start of the match to place the machine in its starting location and prepare it for the match. Temporary alignment marks on the field are not permitted. Additional team members may assist in setting up the machine, but must leave the field area prior to the start of the match.
6. The machine, driver and spotter must be in the designated location(s) at the start of the match to score any points during the match. The driver and spotter must remain in the designated areas during the match.

7. Spotters and drivers are not allowed to handle the game pieces prior to a match.
8. A maximum of 30 seconds will be allowed at the end of each match for removal of the machines. Additional team members may assist in removing the machine.
9. A referee will untangle machines that become entangled with part of the field, or each other, for more than 10 seconds or that appear to be damaging the field because of the entanglement.

## 4.2 Field Colors

1. Painted field areas, driver's/spotter's locations, robot starting areas, etc., which designate specific team locations should use the colors specified in the following table:

Color	RGB Code	Pantene Code
Bright Red	196/40/27	032C
Bright Blue	13/105/171	293C
Bright Yellow	245/205/47	116C
Bright Green	75/151/74	355C

## 4.3 Drivers and Spotters

1. During a match, only one student member of each team is allowed in the team driver's area and one student member is allowed in the team spotter's area. Adult coaches and teachers are not allowed in either of the areas during matches. Students are not allowed to stand on platforms of their own construction (or each other) to get a better view.
2. Only one person per match is allowed to drive the machine (i.e., operate the VEXnet Joystick). Prior to the competition, each team must submit a driver list to the organizers. The minimum number of student team members on the driver list is shown in the following table:

Student team members <b>present</b> at competition	<b>Minimum</b> number of students on driver roster
2-4	2
5-6	3
7-8	4
9 or more	5

*Please note that the previous table reflects the minimum number of drivers required; BEST encourages participation by as many team members as possible. Also note that the number of student team members present at the competition is used to determine the minimum number of drivers on the list.*

3. The first person on the driver list is the driver for the first match; the second person on the list is the driver for the second match, etc. This rotation will continue for successive matches until the list is exhausted, at which time the rotation will start again at the top of the list. Rotation in successive phases of the competition (e.g., seeding, semi-finals, and finals) will begin where the previous phase rotation left off. If the organizers eliminate a match for any reason, the driver rotation will continue in accordance with the driver list with the driver scheduled for the eliminated match (or matches) being the first driver for the following match.
4. The spotter may be any student from the team.
5. During a match, spotters and drivers may not communicate with anyone through the use of any electronic devices or other signaling technique that involves a signaling aid that is not part of the human body (e.g., signs, sticks, marked gloves, etc. are not allowed).

#### **4.4 Penalties**

1. A 20-second suspension may be assessed for a variety of infractions that are detailed elsewhere in this document. This penalty requires the driver to surrender his or her VEXnet Joystick to a referee for a period of 20 seconds. The referee will return the joystick to the driver upon expiration of the penalty and the machine may continue the match. Penalty decisions of the referees will be final.
2. If a driver touches his or her own machine before any part of it has left the starting area, a 20-second penalty will be assessed after contact ceases. Machine contact within the starting area is allowed only for the purpose of debugging a defective machine (e.g., turning on the on/off switch). If a spotter or driver otherwise touches their own or another team's machine, the machine of the individual doing the touching will be disqualified.
3. Spotters and drivers are not allowed to enter the field during a match. If a spotter or driver enters the field during a match, his or her machine will be disqualified.
4. If a spotter or driver leaves the designated spotter or driver area, a 20 second penalty will be assessed per item 1 of this section.
5. Machines that touch the ground outside the field boundary will be assessed a penalty as described in item 1 of this section. Machines that completely leave the field will be stopped for the duration of the match.

6. Damaging any portion of the field or game pieces may result in disqualification. Intentionally moving or tipping over static portions of the field is considered damaging the field, and will result in disqualification.
7. Referees may instruct the driver of an aggressive machine to cease an action if the referee feels that another machine or the field may be damaged by that action. Referees will disqualify a team from a match if a major breach of the rules occurs.
8. Disqualification is on a match basis, except for non-complaint machines as noted in Section 3.5. Any team that is disqualified will receive zero points for that match.

## 5.0 Other

1. Student eligibility is left to each individual school.
2. All contestants on the gym floor must wear shoes appropriate to the gym floor surface as determined by the sponsoring BEST organization.
3. Each team will be provided with their own workspace in the pit area in which they may place a table with a surface area no greater than 2400 square inches, if a table is not provided by the hub. Each team will have access to one electrical plug for battery charging. The exact specifications may vary from hub to hub.
4. Each team may bring a toolbox with basic hand-tools subject to the safety constraints listed in Section 2.0. If a part is broken during competition and the team cannot repair it with tools or material they have, consult the sponsoring BEST organization. They will make their best effort to help the team replace the part, given local shop and/or spare material availability.
5. Practice time will be available preceding Game Day. Consult the sponsoring BEST organization for times and locations. Tables and electricity will be available on a shared basis and teams must provide their own tools. The same safety rules will apply to practice days as they do during the competition.

## 6.0 Revision History

This section is not part of the Generic Game Rules, but is provided to aid in determining changes to this document.

Rev	Date	Impact	Summary of Changes
7	June 2010	Minor	Created section 3.1.1 Construction Requirements (merge of existing rules). Updated sections 3.1.2 Returnable Kit and 3.14 Additional Material Constraints for changes in Return Kit components and their use.

6	August 2010	Minor	Added rule in section 3.6 covering connection of external devices to joystick during match play.
5	June 2010	Minor	Replaced references to R/C and BRAIN with VEX components. Modified section 3.6 item 9. Removed requirement for safety glasses. Added 4.2 on field colors.
4	October 2008	Minor	Added specific restriction and penalty for drivers and spotters leaving designated area during match.
3	May 2008	Minor	Removed references to DSP & BRAIN specific rules & kits to be consistent with exclusive use of the BRAIN-based kit. Removed references to speed controllers.
2	July 2007	Minor	Included references (Section 1.0) to rules governing use of the BRAIN system.
1	January 2006	Minor	Modified rules for returnable belt use (Section 3.1.1, Item 5). Added item 9 to section 4.1
0	August 2005	N/A	Initial release.